INCAS - National Institute for Aerospace Research
"Elie Carafoli"

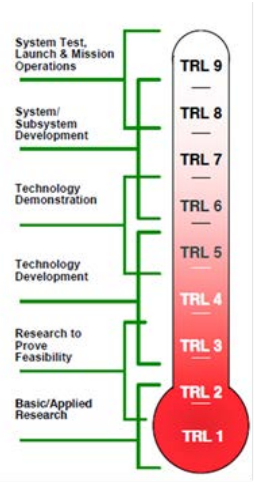
Bucharest - ROMANIA

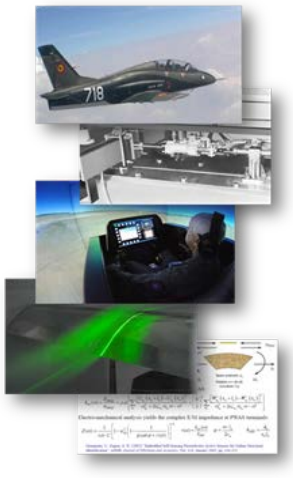
INCAS - National Institute for Aerospace Research "Elie Carafoli" is the leading research establishment in aerospace sciences in Romania, with more than 60 years tradition in aerospace engineering, flow physics and applied aerodynamics, using state-of-the-art technologies and unique infrastructure of national strategic importance. The Institute is a comprehensive research establishment, fulfilling a national and international role in providing world class capabilities across the whole spectrum of basic and applied research in aerospace sciences, industrial support and specialized expertise. INCAS performs this mission in an integrated environment with industry and academia, and supported by higher education training in areas reflective of the Institute's mission.

Reorganized in December 2008 under HG 1463, INCAS has been repositioned as a research establishment, acting under public law as INCD, coordinated by Ministry of Education. This transformation recovers the original position of INCAS as a successor of INCREST - National Institute for Scientific and Technological Creation before 1990 and follows 20 years of activity as a state-owned research company. INCAS is located in Bucharest (main administrative location) and two different working bases for special applications in Maneciu-Prahova and Strejnic Airport with specific infrastructure.

All Romanian projects in aeronautics were developed in INCAS (e.g. IAR-93, IAR-99, IAR-705), and also international developments (e.g. BAC 1-11/ROMBAC). Currently INCAS is the leading design authority for AeroTAXI subcommuter scale CS-23 aircraft (12 pax.) and system integrator for future IAR-XT trainer.

INCAS is a unique research establishment in Romania performing research in the full range of TRL scale, mainly due to the combination of the following capabilities associated with a very successful historical background:





- Research establishment in aerospace sciences, with dedicated organization based on projects and integrating academic criteria for excellence;
- System integrator and design authority for all major aeronautical civil and military programs, with EASA recognized DOA capability;
- Operator of a large experimental infrastructure, including facilities of national strategic importance.

The R&D department is the main component of INCAS structure, with almost 61% of the personnel and more than 82% of the personnel with university degree. In FY 2012 the R&D department counts for 90% of the total business of INCAS in direct area of activities, from national and international contracts. With respect to the INCAS policy, R&D department has the following structure:

A. Flow Physics Department

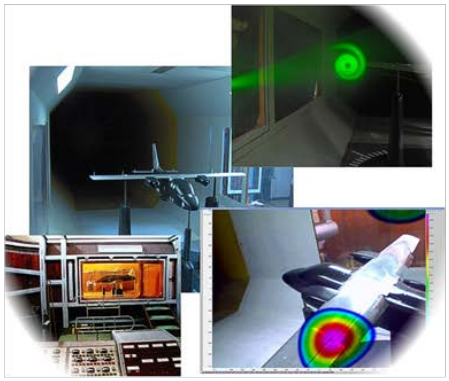
INCAS has a very strong tradition in flow physics. This expertise has been continuously upgraded in major areas where INCAS could identify development potential, niche competences and world-wide recognition. This department makes usage of both experimental facilities (mainly Subsonic Wind Tunnel, Ludwieg/Shock tube and Supersonic Blowdown Wind Tunnel), flying lab Beechcraft King Air C90 GTx, as well as HPC resources.

General Aerodynamics Unit: - Unit dedicated to all areas related to traditional research in aerodynamics, from basic theoretical models to complex understanding of aerodynamic design of advanced flying vehicles. MDO and virtual simulation tools are available for this department for aircraft and spacecraft design, in an interactive environment with other INCAS departments.

Supersonic Wind Tunnel

Numerical Simulation Unit: - Unit dedicated to most advanced numerical methods for complex industrial flows, including multifluid/multiphase non/reacting capabilities, implemented on high performance computing resources. Grid and Cloud computing is part of the latest technologies enabling complex simulations in aeronautics, including fluidic interactions, fluid-structure interactions and aero-acoustics.

Experimental Aerodynamics Unit: - Unit of special interest, where most advanced experimental facilities are operated, from the Subsonic Wind Tunnel (2.5mx2.0m test section, 110 m/s) up to Supersonic Wind Tunnel (1.2mx1.2m, Mach 0.1...3.5, MReynolds > 100), one of the most advanced facilities in the world. A combined Shock/Ludwieg Tube is a major asset, mainly for space related activities. This unit has state-of-the-art technologies for advanced experiments, data acquisition systems and visualization, including latest developments in aero-acoustics, robotics and opto-electronics.



Subsonic Wind Tunnel

Environmental Aerodynamics Unit: - Unit with a very dynamic development in the last years, taking advantage of the latest developments and investments in INCAS flying lab for atmospheric studies. Frontier research in flow physics and chemistry is considered complementary to advanced validation for the large scale simulation models in meteorological studies. AtmosLab is the main infrastructure for applied research for this unit, using state-of-the-art on-board equipment and sensors.

AtmosLab

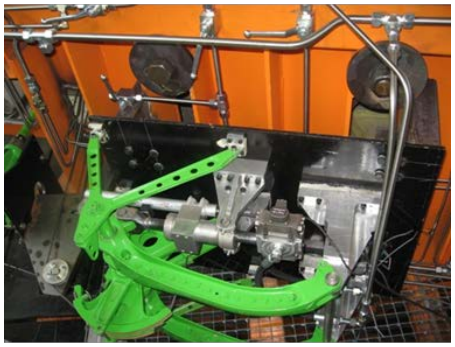
B. Systems Department

INCAS mission was strongly linked to major aeronautical programs, where flight dynamics and systems were key areas for new developments. Key capabilities have been constantly developed using both advanced theoretical models and experimental facilities on a two pylons structure:

Systems Dynamics Unit: - Unit dedicated in the past to major flight dynamics developments, from both theoretical and experimental perspective. Currently this unit is expanding towards more complex activities related to major challenges for the integration of unmanned systems in the future air traffic system, complex scenarios for steep ascent/descent for green operations, new generation of collision avoidance systems and formation flying simulation scenarios. Unit infrastructure includes advanced simulators for flight dynamics and virtual reality augmented simulation environments. Space dynamics, satellite formation flying as well as new launcher systems for low orbit are new areas for development of this unit.

Operations and Future ATS

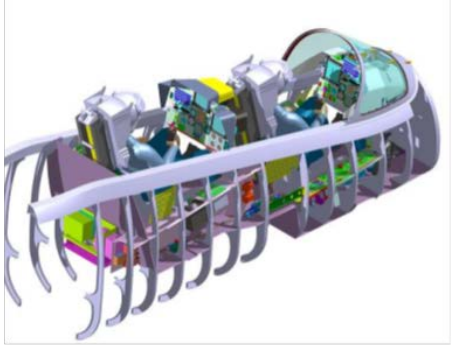
Mecatronics Unit: - Unit dedicated to the area of smart systems and critical components in the new generation of flying vehicles. This units integrates expertise from basic aerospace systems up to new generation of smart structures, health monitoring using on-board and on-ground systems, morphing structures and control systems. Unit infrastructure includes state-of-the-art capabilities for advanced validation and certifications for basic systems, testing in harsh environments and advanced capabilities for large scale simulations for complex industrial products. Industrial developments for ground based demonstrators, testing for industrial certification of subsystems and virtual maintenance simulators have been initiated by this unit with major industrial partner in Europe.



Mecatronic systems

C. Structures & Materials Department

INCAS is design authority for all major aeronautical programs developed in Romania. Acting in an integrated environment with industry, INCAS has developed outstanding capabilities for design and analysis of modern aero-structures, integrating state-of-the-art capabilities for virtual enterprise. At the same time, a continuous effort enabled materials department to developed new materials with advanced properties for aeronautical usage, with important spin-off capabilities. This integrated approach enables enable INCAS to provide full expertise from conceptual structural design using new materials up to structural testing and validation for the benefit of the industrial partners.



Airframe Design and Analysis

CF/ mesophase matrix fairing

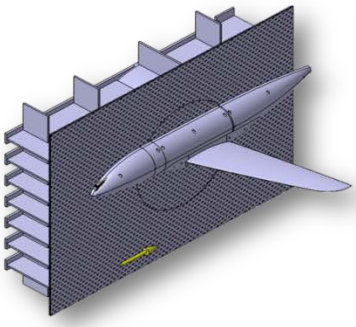
Aero-structures Unit: - Unit based on advanced design capabilities, using CATIA environment and an integrated set of tools for structural analysis, complex mechanical and kinematic simulations. INCAS is also involved in in-house code development for structural analysis, mainly with respect to composite materials and structural integrity evaluation. Capability to work using state-of-the-art industrial tools enabled INCAS design team to be integrated into development teams of all major industrial partners. A special team is dedicated to wind tunnel model design and manufacturing, where almost all models for INCAS wind tunnel testing activities have been produced, for the benefit of aeronautical industry. Interconnectivity with new generation of unconventional manufacturing units, including 3D printers and virtual prototyping has been implemented in the last years.

New Materials Unit: - Unit dedicated to development and testing of new materials for aeronautical applications. Due to a natural spin-off activity, the customer area for the proposed new materials is much broader, from heavy industry to space application, thus making this department a very competitive one. State-of-the-art technology is used for the experimental characterization of the new materials developed (mainly for carbon fibers). Latest experimental facilities include a unique thermal shock facility used in order to qualify materials for aeronautics and space industry.

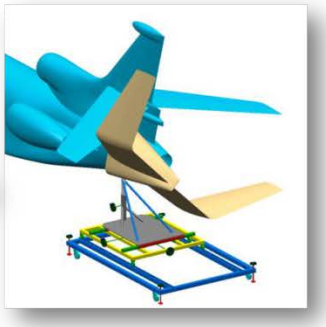
INCAS major on-going projects (selection)

1. INCAS is associated member of JTI Clean SKY, the largest ever program for aeronautical research funded in EU for 2008 – 2016. Clean Sky is the European aeronautics industry's response to citizens' needs for more environmentally friendly aviation in combination with sustained economic growth. This seven-year research program of total 1.6 billion Euro combines public and private capacities to rapidly introduce advanced technologies for the next generation of aircraft. The aim of these new technologies will be to radically reduce noise and emissions in air transport, and reduce aircraft fuel consumption.

INCAS has a very extended involvement in 2 major ITDs: Smart Fixed Wing (SFWA) ITD and in Green Regional Aircraft (GRA) ITD, either as a single entity or part of a consortia, with research activities from low TRL, as for the active flow control technologies for high lift systems and low noise configurations, up to the most spectacular demonstration in Clean Sky, the BLADE demonstrator, where INCAS is in charge with the FTE of the outer-wing development and the very complex structure for the camera POD on top of this flying demonstrator.



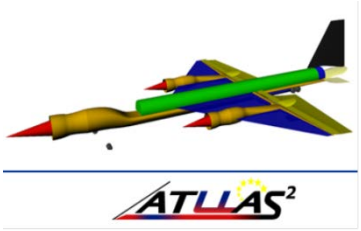
Buffeting control technologies



Biz-jet ground based demo

BLADE flying demonstrator

As part of the low TRL activities, INCAS has performed advanced analysis and wind tunnel testing for active buffeting control technology, using synthetic jets (INCAS patent), as well as the development for a new Krueger LE system for the laminar wing of the biz-jet, also a patent emerging from this project.



2. ATLLAS-2 - Aerodynamic and Thermal Load Interactions with Lightweight Advanced Materials for High Speed Flight is a EU FP7 L1 project, led by ESA ESTEC, built upon the experience and technology development gained within ATLLAS-I. The focus is on advanced light-weight, high-temperature material development – strongly linked to a high-speed vehicle design. Current design is addressing cruising Mach number around Mach 5 to 6 with optimized vehicle with respect to aerodynamic, propulsive, structural and thermal layout but nevertheless complying with restrictions imposed by emissions regulations and sonic boom mitigation. INCAS performs wind tunnel testing for the selected configuration and takes part in the overall optimization process using in-house developments for the multi-disciplinary design process.

3. AFLoNext is a four-year EU FP7 L2 project with the objective of proving and maturing highly promising flow control technologies for novel aircraft configurations to achieve a quantum leap in improving aircraft's performance and thus reducing the environmental footprint.
The AFLoNext concept is based on six technology streams which cluster the targeted technologies and their associated contributions to advanced aircraft performance. INCAS participates as task leader for Hybrid Laminar Flow Control (HLFC) technology applied on the wing for friction drag reduction and thus performance increase in cruise conditions. At the same time INCAS is leader for technologies for local flow separation control applied in wing/pylon junction to improve the performance and loads situation mainly in take-off and landing conditions.

4. HAIC (High Altitude Ice Crystals) is a large-scale integrated L2 project in FP7 which aims at enhancing aircraft safety when flying in mixed phase and glaciated icing conditions. In anticipation of regulation changes according to these particular icing conditions, the HAIC project will provide the necessary Acceptable Means of Compliance (numerical and test capabilities) and appropriate ice particle detection and awareness technologies to the European Aeronautics industry for use on-board commercial aircraft. In particular, within the HAIC project the characterization, optimization, enhancement and selection of the most sophisticated cloud microphysics probes will be performed, and INCAS will contribute with ATMOSLAB capabilities in order to measure mixed phase and glaciated icing conditions during flight tests and to calibrate icing wind tunnels.

5. ESPOSA (Efficient Systems and Propulsion for Small Aircraft) is a FP7 L2 project aiming to develop and prove innovative technologies for a family of small gas turbine engines and related systems that will contribute to the overall propulsion unit efficiency, safety and pilot workload reduction. INCAS has an active participation in engine integration at aircraft level and high temperature testing for new materials for the novel engine architecture, as well as advanced simulations for the overall assessment of the propulsion system with respect to global aircraft performance and direct operating costs.